Mean corpuscular volume changes in different conditions

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Abstract.
Mean corpuscular volume (MCV) informs a lot about condition of the human body including directly or indirectly signaling about plethora disorders as erythrocytes being an oxygen carrying cells by its indicators’ changes elucidate oxygen content status of the organism. The erythrocytes index parameters particularly MCV can be indicative of the result of the many conditions. In current review the data about MCV variations, namely macro- and microcytosis are systematized and analyzed in further three groups: while physiological conditions of human body (age, sex, pregnancy), in different diseases (variety types of anemias, kidney disorders, endocrine system pathology, cardiovascular disorders, chronic obstructive pulmonary disease) including under the treatment of the latter (antiretroviral treatment of HIV, colorectal cancer, phlebotomy), and caused by iatrogenic influence (toxins, smoking, alcohol drinking). Current minireview includes mindful analysis of 20 trials published in PubMed database.

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The mean corpuscular volume (MCV) indicates the average size (volume) of the red blood cells (RBC). This indicator informs a lot about patients’ condition including oxygen content status and any underlying pathological process causing its changes as RBC are the oxygen carrying transporter in humans’ body. MCV level is included in the complete blood test. It can be calculated by packed cell volume divided by RBC count in million multiplying 10 and measured in femtoliter (fL). [1, 2]

Macrocytosis refers to when the MCV value is increased (>100 fL), whereas microcytosis is the term for the condition when decline in MCV is registered (< 80 fL) and normal range is between 80-100 fL. [1]

In current minireview 20 trials from PubMed database are analyzed.

Changes of MCV can be trends in some physiological conditions like age, hydration of the body, fasting for a long period, pregnancy, nutrition condition or even the socioeconomic condition of the person or physical activity. MCV trends can signs of various disorders like anemias, chronic disease of the kidneys, thalassemia or result of iatrogenic influences like antiviral therapy, chemotherapy, vitamins supplements of B12, alcohol, blood transfusion. [2]

A trend of increased in MCV with age can be seen in people with approximate of 6.6 per centage with age but the similar could not be said for gender, here the gender do not play a very significant role with respect to MCV variability. [3]

Milovanovic et al. registered inverse relationship between erythrocyte size and platelet reactivity in elderly. [4]

Even daily habits can change the MCV value in blood, namely smoking, alcohol drinking. Smoking as well as alcohol drinking led to increase in MCV. Of note, some studies have shown that leaving alcohol for a period of one month did not show any significant changes in MCV value but over taking a longer period it may show some significant improvement in the observed indicator in these patients. [5]

In some endocrine disorders it is registered changes in the level of hormones in blood and it is seen also how correspondingly it may change the erythrocyte indices too.
Likewise, a study done by Schindhelm R. on how erythrocyte indices change in thyroid hormone disorder using cohort study in the population of Netherlands, free T4 level was associated to erythrocyte indices but no link was associated with TSH. [6]

It is defined that MCV is an important parameter to classify different types of anemia – microcytic anemia (<80 fL), macrocytic anemia (>100 fL), normocytic anemia (80-100 fL). [7, 8]

The dependence of MCV, MCHC with coronary vascular disease nothing strong could be said as an observation was conducted on 393 patient and got a result that MCV and MCH increased shows higher risk for cardiovascular disease independently whereas, MCHC did not showed a similar trend rather it was independent of the major cardiovascular disease outcome. 393 patients with acute coronary syndrome shows that the increase in MCV one of the factors for major outcome of cardiovascular events. This result took a lot of time and work and using cohort study on patient with acute coronary syndrome. [9]

In anemic as well as non-anemic patient vitamin b12 deficiency will show an elevated value on MCV in blood, as 3500 titer screening shows this. But the specificity and sensitivity of the test to detect vitamin B12 deficiency is doubted. [10]

Whereas in Alzheimer disease patient shows macrocytosis or increase in the MCV is seen due to toxins accumulations in the RBCs and a parallel study was also done along with it i.e the action of platelet in Alzheimer’s disease taking into account elderly hypertension people. It showed an inverse relation between MCV and platelet binding activity. [11]

Regarding microcytosis, it is typical of patients with iron deficiency, anemia of chronic disease, anemia of lead poisoning.

The MCV value can also be used in the establishment of minimal cutoff value for the diagnosis of the alpha thalassemia was 81.45 fL. To get this result 285 peripheral blood smear of the patient was tested to know the minimal value to MCV in alpha thalassemia patient. Thalassemia is an inherited disorder where body doesn’t make enough alpha goblins so the patient is always anemic. [12]
MCV holds a lot of significance in obstructive colorectal cancer patients as its value can be used to get the outcome after post operative stage in these patients. MCV belong to independent predictors of outcome in some disorders course and treatment. Based on multivariable analysis Sato R. et al revealed that MCV>87 fL status in patient with colorectal cancer after treatment is independent predictor of poor relapse free survival (hazard ratio [HR] = 4.70, 95% confidence interval [CI] 1.52-14.58, P= 0.007). [13]

For some disorders no one-directed trend in MCV changes was identified. For example, a direct correlation cannot be deduced in acute lymphoblastic leukemia patients because some patients like 61% show a normal mcv, 33% show increased mcv and 6% shows reduced mcv from 54 patients and neither a correlation can be deduced at relapse of acute lymphoblastic leukemia. Multiple reasons may lead to such unidentified trend in MCV: heterogenicity in population, some bias while research conduction or simply the absence of any connection between any disorder and MCV indicator. [14]

Some of the disease shows correlations with MCV and effectiveness of medications studied by Kim AH. Measuring MCV in HIV positive patients can be used to check whether the medications are effective or not. According to the study it states macrocytosis is noted when treatment of choice was combined antiretroviral treatment (cART) or zidovudine (AZT). During the entire study by Ah Hyun Kim, 179 HIV positive participants were taken and 687 sera from them were studied. [15]

9 patients undergoing phlebotomy showed different MCV values during the therapy. First it increased then remained constant for some period and then sharply decreased in MCV value was noted in these patients this further can indicated the storage of iron content in the body. [16]

However, there are some diseases where the MCV value does not hold much significance with the onset and outcome of the disease. For instance, in chronic obstructive pulmonary disease MCV did not change or show a noticeable relationship with each other. [17]

As previously discussed, earlier MCV value can be changed in B12, folate, and iron deficient patients but here the same
study was done in a hemodialyzed patients and 18 patients were considered appropriate for this study and to work with and it showed nothing significant could be considerable was found regarding the MCV value.

Nevertheless, in clinical practice it is recommended to analyze the bouquet of erythrocytes indices unlike only one, no matter whether MCV, MCH or others. Only complex analysis of erythrocytes indicator gives all rounded understanding of changes in erythrocyte population. Bright example is study of Fialon et al. MCH, MCV, RDW were analyzed in monitoring chronic hemodialysis patients treated with recombinant erythropoietin. It was found out that only RDW but not MCV, MCH was an effective marker of early detecting iron, folate, B12 deficiency with sensitivities of 62.5%, 72%, 75%. [18]

Parturient ladies during vaginal delivery showed need of oxytocin inversely proportional to higher MCV. This was seen in 54% of the parturient patient. [19]

Besides pathological and physiological changes in MCV value like we observed above there are some more ways to check to changes on MCV and other parameters by experimental. These ways we get to check on how even toxins, deliberate infections have an influence on the body.

Apart from humans the toxins can even affect the animal, the flora and fauna as well. An observation was done by Kannayiram Muthukumaravel on how the phenol content in water can affect the MCV, MCH, and other parameters of blood. It was discussed about the fish Labeo Rohita in fresh water and on exposure to phenol for 7 days decreased the MCV, MCH, MCHC in their blood, and not only blood these chemicals also had an impact on its muscles, liver kidneys as well. [20]

A similar study was also done by A. Kumar where he studies the effect on albino rat on giving a sublethal dose of copper sulphate for 30 days and note the changes in its blood constituents like MCV, MCHC, alkaline phosphate, WBC not much significant changes were observed and others like blood glucose concentration, cholesterol, bilirubin, urea there was an increase in them were noticed. [21]

Another study was done on albino rat a male particularly, 50 of them were taken for the study, infected by giardia lamba. Changes in some parameters were observed after few
days of infection and it was noted that decrease in RBC, MCHC, and increase in MCV, MCH, platelet. Some other parameters like WBC, lymphocytes, immunoglobins, cytokines and others were also taken into account post infection.

Not only experimentally, physiologically, pathological but we have some cases when there were substantial changes in hematological parameters can be changed due to some medications. [22]

Use of isotretinoin for acne vulgaris patients, 118 patients volunteered for the study and changes in the hematological changes during the treatment was concluded after subsequent time period of the treatment. According to general linear analysis which was used in the study there were some changes and disorganized results were seen at the begging and end of the therapy. MCV value increased at the end whereas other parameters decreased and then increased during different periods of the treatment. So, there cannot be a constant effect was seen with the isotretinoin whether it will increase or decrease the MCV value rather it was a random up down fashion noticed. [23]

Some parts of the world where children don’t get sufficient food, vitamins, minerals and having a poor diet will be having a different hematological index and a biochemical parameter in these children were studies.

A brilliant work by Arijit Ghosh and his collogues where they studied the hematological parameters on undernutrition children and comparing it with the well the nourished children. He took several parameters for the study like MCV, MCHC, MCH, total count of RBC, and other biochemical parameters. He noticed there was a huge difference in the biochemical in both conditioned children were of course the undernutrition children showed deficiencies of vitamin and minerals, iron. Whereas the hematological value MCV, MCH, for undernutrition children was towards higher side.

Conclusion: physiological, pathological, hormonal changes, even the daily habits cause the change in mean corpuscle value in blood and any change in the MCV value can be indicative of some disease. So, checking just the MCV value may not always lead us to the direct cause of it but give an idea of some pathological changes. Shift of MCV towards both the ends macrocytic and macrocytic is indicative of some
disease or underlying unfavorable changes in the body. Most of the disease where there is toxic accumulation in the RBC, oxygen tension, some metabolic disease leading to low oxygen in the body, cardiovascular disease generally a trend of increasing MCV is seen. On a contrary some condition will not indicate any change in the MCV value in spite of having some pathological changes in the body like we in COPD exacerbation and some anemias like group of normocytic anemia.

References:


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